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LOCKYER'S conclusion that at sun-spot maximum most of the known lines in spots are replaced by lines of unknown origin.

(4) All of the silicon lines in the region studied are much weakened, while other substances have only a small proportion of weakened lines.

(5) Table III gives the measured wave-lengths of the faint ("band") lines photographed in the region λ 5030 – λ 5215. Comparison with ROWLAND'S table shows that these lines, which are considerably strengthened in spots, correspond with the extremely faint lines of the solar spectrum.

(6) A review of the literature indicates that these lines are the ones seen visually by YOUNG, DUNÉR, and others who have resolved the general absorption in spots, and that they account for most, if not all, of the so-called "bands."

(7) Our results confirm YOUNG'S conclusions that the absorption in sun-spots is due to gaseous matter, and not to solid or liquid particles.

(8) After discussing the views of EVERSHED and WILSON on the cause of the darkness of sun-spots, we conclude that it may be sufficiently well accounted for by absorption alone.

GEORGE E. HALE AND WALTER S. ADAMS.
SOLAR OBSERVATORY.

COLOR OF THE SHADOWS OF *JUPITER'S* SATELLITES PROJECTED ON THE DISK OF THE PLANET.

On the evening of December 23, 1905, I was showing the visitors *Jupiter* through the large refractor. The seeing was good and the sky clear. The shadows of satellites I and III were on the disk of the planet. The shadow of I fell upon the dark-red equatorial belt of the planet near the meridian, just northwest of the great red spot; the shadow of III had just entered upon the disk very near the south pole of the planet.

It was at once seen that the two shadows were not equally dark. The shadow of III was a dense black, while that of I was not completely devoid of color. The character of the backgrounds was quite different, that upon which the shadow of I was projected being several shades darker than the white, cloudy region upon which the shadow of III fell. The effect of contrast would be, of course, to make the shadow which fell upon the brightest region (III) appear the darkest. The

shadows were, however, of appreciable size, so that it was possible to study them to some extent as *surfaces* and not as mere *points*. Then, too, the shadow of III was much larger than that of I, which should tend to reduce somewhat the effect of contrast. The difference of brightness in the backgrounds was carefully considered at the time of observation, and, after making what was considered an ample allowance for any such effect, the shadow of I appeared to have a decidedly more brownish color than the shadow of III.

Powers of 270 and 520 were used. The latter power, especially, gave the shadows sufficiently large disks for me to feel very certain of the color in that of I, and to feel equally certain that the blackness of III was real. The difficulty of properly interpreting such an observation is fully recognized.

It is seldom that the shadows of two of the satellites fall together upon favorable portions of the planet's surface for such an observation as the above. My reason for publishing this single observation is to call it to the attention of observers having the use of large telescopes, in the hope that they may take advantage of any opportunity to compare the density of the shadows of any of the satellites.

There can be little doubt of the absence of sensible atmosphere upon the Jovian satellites, and in that event any light in their shadows would have an important bearing on the physical condition of *Jupiter*. Such a condition, if established, would go far toward proving the high internal temperature of that planet and explaining the rosy color of the equatorial belts.

MT. HAMILTON, January 25, 1906. C. D. PERRINE.

THE SIXTH AND SEVENTH SATELLITES OF *JUPITER* AT THE OPPOSITION OF 1905-1906.

The sixth satellite was first observed, at the present opposition, on July 24th by Mr. ALBRECHT, Fellow in Astronomy at the Lick Observatory, with the Crossley reflector. He had the assistance of Mr. ELLIOT SMITH, also Fellow at the Observatory.

The satellite was then in position-angle 56°.6 and at a distance of 26′.0 from its primary. A comparison with Dr. Ross's ephemeris, printed in *L. O. Bulletin* No. 78, indicated a lengthening of his period to 251 days and small corrections